International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Intrahospital Cardiac Arrest in a Tertiary Care of Hospital and Outcome of Resuscitation by Code Blue Team: An Observational Study

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Abstract: ***Background: Intrahospital cardiac arrest etiology could becardiac, respiratory, metabolic, infective or hemodynamic instability. Early CPR improves the survival. A CPR skilled team referred as Code Blue Teams (CBT) in hospitals plays crucial role in outcome. An observational study was conducted to study various aspect of resuscitation by Code blue team. Material & Methods: In our hospital. Multi-code Automated Event Response System (MAERS) is used for code blue initiation. Data was collected on demographic, indication, cause of arrest, rhythm whether shockable or non-shockable, duration of CPR, time pattern, location and resuscitation outcome. Data collected was analyzed using relevant statistical tests. Result: On analysis in 61890 admissions during study duration, deaths recorded 1356 (2.2%), code blue initiated in 342 (25.22%). Non shockable rhythm, malignancy diagnosis wise and cardiac arrest was most common cause followed respiratory arrest. Statistically significant impact on outcome in terms of duration of CPR (most revived in 20 minutes of CPR), type of rhythm, (revival rate 97.1 %in NSR, 57.1% in shockable and 21.8%in non-shockable rhythm) and highest ROSC in Respiratory arrest in compare to cardiac arrest. Conclusion: Code blue plays crucial role in resucitation outcome of intra-hospital cardiac arrest and various factors like rhythm type, diagnosis, duration of CPR, early initiation lays a significant role.***

Keywords: Code blue, Cardiac Arrest, Resuscitation, Shockable rhythm, Asystole Ventricular Fibrillation

1. Introduction

Any Cardiac arrest which happens after admission in-hospital or in a hospitalized patient who had pulse on admission to the hospital is intrahospital cardiac arrest. This arrest could be because of cessation of cardiac contractility resulting in pulselessness and apnea. Respiratory arrest, characterized by apnea with a palpable pulse. The in-hospital arrest is often the last event of patient's progressive deterioration that may have pathological vital signs for hours or days before the arrest. These precursor elements are recorded but appropriate actions which could possibly prevent the arrest aren't implemented timely. (1)

Ischemic heart disease is the leading cause of death worldwide. In Europe, cardiovascular diseases account for 40% of deaths in age groups up to 75 years. The sudden cardiac death is responsible for over 60% of adult deaths from coronary heart disease. The survival rate and discharge from the hospital is 10.7% for cardiac arrest from all cardiac rhythms and 21.2% for cardiac arrest from VF. These rates vary across continents.

The reported incidence of in-hospital arrest ranges between one to five cases per thousand admissions. Data from the UK National Cardiac Arrest Audit (NCAA) suggest that the survival and hospital discharge after in-hospital arrest is 13.5%. Another data from the National Registry of Cardiopulmonary Resuscitation (NRCPR) of the United States reported that amongst 14, 720 intra hospital cardiac arrests observed in 287 hospitals, return of spontaneous circulation varied from25 to 67% in successfully resuscitated patients. Generally, the immediate implementations of CPR can double the survival of cardiac arrest victims. (2-4)

To bailout heart and treat reversible conditions which led to this condition immediate CPR is required and should be instituted within 3-4 minutes before organ dysfunction starts due and brain being most oxygen sensitive organ with minimal reserve is most susceptible to irreversible brain damage. Moreover, for every minute that passes without applying CPR, the survival of patients with ventricular fibrillation (AF) is reduced by 7-10%.3 If the CPR is not applied immediately, the decrease of survival rate ranges between 3-4%. (2, 3, 5)

According to the above data there is an urgent need for Resuscitation Team operating in the hospital, composed of

trained and qualified staff to be available duty 24 hours a day throughout the year. (6)

Anywhere in hospital, staff can call this emergency team during arrest or in any hemodynamic unstable condition either by pressing a button which is easily accessible throughout the hospital or by a telephone/ Mobile number. These teams in the literature are referred as Code Blue Teams (CBT) or Rapid Response Teams (RRT) or Medical Emergency Teams (MET). This term was coined first time in Bethany Medical Centre in Kansas, by medics for emergency. The term Code Blue implies that an immediate need for resuscitation is required for rescue or prevention of cardiorespiratory arrest. The code blue team consists of professionals, with assigned role and responsibility to respond every call as per institute's protocols. In Europe, America, Canada, Australia, the code blue is implemented successfully. (7, 8)

This observational study conducted at 800 bedded tertiary care center with main objectives to estimate the incidence of cardiac arrest and assess the impact of Code blue team on Return of Spontaneous Circulation (RSOC). Other objectives were to estimate the incidence of intrahospital cardiac arrest in various age group, location, gender, timing of day, duration of CPR, type of Disease. Impact of Code blue team in resuscitation outcome in terms of return of spontaneous circulation in different age, location of wards, gender, diurnal variation, duration of CPR, cause of arrest, type of rhythm.

2. Material & Methods

Our hospital is a large tertiary care hospital, with wards and departments spread over a very large area. MULTICODE AUTOMATED EVENT RESPONSE SYSTEM (MAERS) which alerts in events of emergencies like Cardio respiratory arrest, fire emergency and Disaster occurring in the premises of the hospital.

Code blue Team is generally stationed at OT during working hours and in ICU during off duty hours. It responds when Code blue activated. All the Code blue calls are recorded by team in a standard format, for the CPR performed in various wards, like acute medical, surgical ward, OPD's, causality and trauma center, CCU, dialysis center, cath labs and other peripheral wards in the hospital. In ICU all cardiac arrest cases were attended by the critical care team.

MAERS programmed Code Blue is activated by dialing Emergency No 6666which displayed and widely disseminated at all wards and OPDs. Emergency message is forwarded to the Code Team placed in hospital. CLI (Caller Line Identification) is enabled on all phones and the origin of the call is tracked automatically. This location is included in the SMS, which the Code Teams receives. There is no need to speak into the phone or attempt redialing. Phone can be hang up once the automated confirmatory message is confirmed. This helps rescuer to return to the site of the incident and begin administering Basic Life Support (BLS) till the arrival of the Code Blue Team. This step is both mandatory and crucial since the Code Blue Team in our hospital take time to arrive which is being utilized for Compression.

This team is headed by anaesthesiologist on call along with anaesthesiology resident, Operation Room Assistant, Medicine resident on call, medical officer (JDMO/ADMO in A&E). Code team stationed at OT complex rushes towards ward with all equipment of resuscitation which comprises of airway adjunct, laryngoscope and all lifesaving medicines and IV fluids, monitors, manual defibrillators, anaphylactic tray and manual suction along with team.

Data collected were recorded in code blue form every time team performed CPR in standard format (refer Figure 1) in terms demographic profile, indication of code blue activation, clinical profile of patient, cause of arrest, type of rhythm in terms of shockable or non-shockable, duration of CPR by code blue team, Code blue activation pattern in a day, location and outcome of patient. All the cases for whom code blue team was activated during study period from 01Jan 2019 to 31 August 2021 were included and collected data for different attributes were analysed with SPSS 2021.

3. Results

Total Admissions during study duration i. e from 01 Jan 2019 to 31 August 2021 recorded were 61890. In that duration total numbers of deaths registered were 1356. Incidence of death in total admission was 2.2%. In this code blue team received call for 342 cases. Incidence of code blue activation was 342 in that period i. e.25.22%. All other deaths, for which code blue was not activated, occurred in critical units where resuscitation was carried out by critical care team stationed in ICU.

Amongst demographic profile, Ref Table1 Code blue team was activated for 342 cases in which 121 (35.4%) were female and 220 (64.6%) were males and among them 19 (5.6%) were in age-group of 1 to 20 years, 20 (5.8%) were in 21 to 40 years, 130 (38%) were between 41 to 60 years, 160 (46.8%) were in 61 to 80 age group and 13 (3.8%) were more than 80 years. So maximum number of cases of arrest belonged between age Gp 40-80 Yrs (84.8%)

Table 1: Demographic distribution

Age Group	Gender		Total (%)
	Female (%)	Male (%)	
1-20	10	9	19 (5.6)
21-40	6	14	20 (5.8)
41-60	49	81	130 (38.0)
61-80	52	108	160 (46.8)
>80	4	9	13 (3.8)
Total	121 (35.4)	220 (64.6)	342 (100)

On arrival of code blue rhythm recorded on monitor for which code activated were, Asystole was 236 (69%), Normal sinus rhythm (NSR) recorded 66 (19.3%), Bradycardia 25 (7.3%), Broad QRS Complex 14 (4.1%) and only one patient had pulseless electrical activity (PEA). (Figure 2)

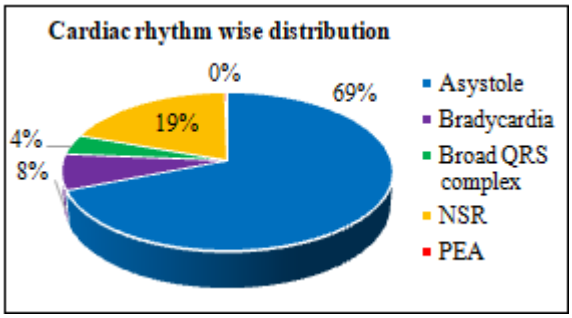

Figure 1: Distribution as per Cardiac rhythm

Regarding diagnosis and code blue activation spectrum of diseases were, 67 (19.6%) malignancy, 43 (12.6%) Cardiac disease, 41 (12%) Chronic Kidney Disease, 49 (14.3%), CNS Disorder, 32 (9.4%), 30 (8.8%) respiratory Distress, 30 (8.8%) Sepsis, 19 (5.6%) GIT Disorder, 7 (2%) Post Severe COVID pneumonia and 24 (7%) were found Dead with cause unknown.

Table 2: Distribution as per Diagnosis

Diagnosis	Frequency	Percentage
Cardiac Disorders	43	12.6
Chronic Kidney Disease	41	12.0
CNS Disorder	49	14.3
Found Dead Cause Unknown	24	7.0
GIT Disorders	19	5.6
Malignancy	67	19.6
Post Severe COVID Pneumonia	7	2.0
Respiratory Distress	30	8.8
Sepsis, MODS	30	8.8
Trauma	32	9.4
Total	342	100.0

On analysis of association of various factors **on outcome of revival rate on the patients underwent resuscitation by code blue team of CHWC**. It was observed that code blue team was able to revive 86 (38.9%) males as compared to 43 (35.5%) female and there was no statistically significant difference between proportions of revival cases after cardiac arrest between male or female.

Similarly, there was no difference on revival of cases between the age-groups who were more than or less than 50 years.

Table 3 Association of Revival with different Attributes

Attributes	Declared Dead (%)	Revived (%)	Total	P Value*
Outcome as per gender Distribution				
Male	135 (61.1)	86 (38.9)	221	0.310
Female	78 (64.5)	43 (35.5)	121	
Outcome as per Age Distribution				
<50 Years	47 (58.0)	34 (41.9)	81	0.431
>50 Years	166 (63.6)	95 (36.4)	261	
Outcome as per type of Ward				
A&E	106 (64.2)	59 (35.8)	165	0.140
Acute Ward	91 (64.5)	50 (35.5)	141	
Peripheral Ward	16 (44.4)	20 (55.6)	36	
Outcome as per Rhythm				
Shockable Rhythm	6 (42.8)	8 (57.1)	14	0.107
Normal Sinus Rhythm	2 (3.1)	64 (96.9)	66	
Non-Shockable Rhythm	205 (78.2)	57 (21.8)	262	
Outcome as per Time of CPR				
0001-0800	52 (74.3)	18 (25.7)	70	**0.057**
0801-1600	81 (60.9)	52 (39.1)	133	
1601-2400	80 (57.6)	59 (42.4)	139	
Outcome as per Diagnosis				
Cardiac Causes	28 (65.1)	15 (34.9)	43	0.739
Non-cardiac Causes	185 (61.9)	114 (38.1)	299	
Outcome as per Type of Arrest				
Cardiac Arrest	170 (84.2)	32 (15.8)	202	**0.000**
Respiratory Arrest	43 (30.7)	97 (69.3)	140	

*Pearson Chi-Square test

It is observed there was no statistically significant difference between proportions of revival cases from different wards.

It is observed that code blue team was able to revive 57.1% who had shockable rhythm, 97.1 % were revived who had normal sinus rhythm (NSR). as compared to 21.8% persons having non-shockable rhythm were only got revived, which was statistically significant difference between proportion of revival cases between shockable or non-shockable rhythm.

It is observed that proportion of cases who revived during 0001 hrs to 0800hr is statistically significantly lower as compared to who revived between 0800 hrs to 1600 hrs or 1600 hrs to 0001 hrs.

It is seen that 34.9% who suffered with cardiac causes could be revived while 38.1% of those who suffered with non-cardiac causes could be revived by code blue team which is statistically not significant.

It was observed that 69.3% who suffered respiratory arrest could be revived while 15.8% of those who suffered cardiac arrest could be revived by code blue team which is statistically significant.

4. Discussion

Although improvements in resuscitation outcomes for in-hospital cardiac arrest (IHCA) have been reported over the last two decades but the mortality rate of patients with IHCA remains relatively high.

In our study incidence of ICHA was recorded 22 per 1000 during study period. The incidence of IHCA has been reported by various hospitals across Europe and US were ranging from 1 to 13per 1000 admissions in number of studies. ((9-13)

In 1356 deaths code blue activation was done in 342 cases (25.22%) only, which remains similar as reported in various other studies (7, 14-17)

In our study Code blue was activated for 50.6%cases with age more than 60yrs and amongst them 65% were male, similarly the mean age of patients suffered in-hospital cardiac arrest in the United States Hospital were 66 years and in them 58% were male. On arrival of code blue team rhythm recorded on monitor predominantly (69%) was asystole. Other studies also recorded similar rhythms mostly non-shockable in the range of 54% to 82%. Benjamin et al in 2018 also reported that around 81% of initial presenting rhythms in cardiac arrest were non-shockable i. e., asystole or pulseless electrical activity. (18-20)

In review article by Andersen LW et alin 2019described etiology of cardiac arrest in hospital were cardiacup to 50% to 60%and respiratory (15% to 40%) (12).

Although K. Moriwaki et al. described Respiratory, cardiac and end-stage malignant diseases together 30%as etiology of cardiac arrest. The low prevalence of cardiac causes of cardiac arrest because they list end-stage malignant diseases as an independent etiology of IHCA. In our study also patients predominantly had malignancy. In all diagnosis where IHCA occurs, terminal event is cardiac most common (50% to 60%) generally due to myocardial infarction, arrhythmia, or heart failure and respiratory insufficiency is second most common cause (15%-40%). (19, 21)

The univariate analyses showed that cardiac arrests treated from 2013 to 2017 were associated with a higher ROSC when administration of adrenaline was not required and in cardiac arrests treated with respiratory intervention also reported higher ROSC. In our study also patients with pure respiratory arrest revival were 69.3% statistically significant compared to 15.8 % patients who had suffered with cardiac arrest.

In the multivariate logistic analysis and considering confounding factors, there was no significant correlation with age, dysrhythmia and shockable VF/VT rhythms with ROSC. Similarly, our study also observed no statistical difference on revival of cases between the age-groups who were more than or less than 50 years, cardiac versus non cardiac causes like malignancy, trauma, sepsis and metabolic.

In comparison to acute wards (HDU's, CCU, PICU) with Chronic wards with relatively stable patients, no significant difference between proportion of revival of ICHA were noticed. Similar to our observations other studies also reported non-significant difference in revival rate in chronic wards when compared to intensive care units and operating rooms. (18-19)

In contrast to these few studies have reported that rate of revival is high in acute wards compared to chronic wards. The rate of revival varied from 35% to 65% as reported by various studies in acute vs chronic wards. (9, 11, 14).

Two of the factors strongly associated with outcomes are the presenting rhythm and the duration of the cardiac arrest. In current study it was observed that maximum numbers of patients were revived in less than 20 mins. This similar fact was observed in which, resuscitation longer than 15 minutes was associated with significantly decreased survival to discharge. (22-25)

It was observed that code blue team was able to revive 57.1 of patients **who had shockable** rhythm as compared to 36.9% with non-shockable rhythm. This fact is supported by another study where patients with a shockable rhythm had 2 to 3 times higher survival to hospital discharge in comparison to patients with a non-shockable rhythm. (27-30)

Targeted education and training regarding treatment of cardiac arrest directed at emergency medical services (EMS) professionals as well as the public has significantly increased cardiac arrest survival rates. If on-site nurses and other medical staff have been sufficiently trained for basic life support using AED, improvements in outcome with shockable rhythms were observed. (30-35)

It was also observed that revival rate was higher during day time compared to Night. There is significant difference in

RSOC if we see diurnal pattern which is again matter of study and is not highlighted much in previous studies.

5. Limitations

This study had its limitations as it is single-center observational study and the number of cases was small. Thus, the findings of the present study need to be verified in prospective studies with a larger sample size. Moreover, our area of investigation was whole hospital except ICU and OT which are less monitored with multiple variables fact patients whose cardiac arrests occurred in non-monitored areas. Hence this study shows factors affecting resuscitation outcomes in HDU and peripheral wards that occurred of a hospital, which excludes an ICU and Operation theatre.

6. Conclusion

Code blue team is activated generally for HDU and less monitored wards. Outcome of patients in these wards depend upon multiple factors viz. cause of arrest, type of rhythm and diagnosis, To provide round the clock Code blue efficient cover factors leading to diurnal variations like manpower, training and other factors need to be studied.

7. Conflict of Interest

There is no financial or any other support from anyone

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